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(54) Steganographical embedding of auxiliary data and calibration data in image data

Steganographisches Einbetten von Zusatzdaten und Kalibrierdaten in Bilddaten

Incrustation par stéganographie de données auxiliaires et de données de calibration dans des données d'image

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- **PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON IMAGE PROCESSING (IC, AUSTIN, NOV. 13 - 16, 1994, vol. 2 OF 3, 13 November 1994, INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, pages 86-90, XP000522615 SCHYNDEL VAN R G ET AL: "A DIGITAL WATERMARK"**
- **RESEARCH DISCLOSURE, no. 358, 1 February 1994, page 75 XP000439803 "AUTHENTICATION AND DISPLAY OF SIGNATURES ON ELECTRONIC DOCUMENTS"**

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uous carrier (e.g. a photograph associated with the product), or by encoding the microtopology of the merchandise's surface, or a label thereon.

[0498] There are applications -- too numerous to detail -- in which steganography can advantageously be combined with encryption and/or digital signature technology to provide enhanced security.

[0499] Medical records appear to be an area in which authentication is important. Steganographic principles -- applied either to film-based records or to the microtopology of documents -- can be employed to provide some protection against tampering.

[0500] Many industries, e.g. automobile and airline, rely on tags to mark critical pans. Such tags, however, are easily removed, and can often be counterfeited. In applications wherein better security is desired, industrial parts can be steganographically marked to provide an inconspicuous identification/authentication tag.

[0501] In various of the applications reviewed in this specification, different messages can be steganographically conveyed by different regions of an image (e.g. different regions of an image can provide different Internet URLs, or different regions of a photocollage can identify different photographers). Likewise with other media (e.g. sound).

[0502] Some software visionaries look to the data when data blobs will roam the datawaves an interact with other data blobs. In such era, it will be necessary that such blobs have robust and incorruptible ways to identify themselves. Steganographic techniques again hold much promise here.

[0503] Finally, message changing codes -- recursive systems in which steganographically encoded messages actually change underlying steganographic code patterns -- offer new levels of sophistication and security. Such message changing codes are particularly well suited to applications such as plastic cash cards where time-changing elements are important to enhance security.

[0504] Again, while applicant prefers the particular forms of steganographic encoding detailed above, the diverse applications disclosed in this specification can largely be practiced with other steganographic marking techniques, many of which are known in the prior art. And likewise, while the specification has focused on applications of this technology to images, the principles thereof are generally equally applicable to embedding such information in audio, physical media, or any other carrier of information.

[0505] Having described and illustrated the principles of my technology with reference to numerous embodiments and variations thereof, it should be apparent that the technology can be modified in arrangement and detail without departing from such principles. Accordingly, I claim as my invention all such embodiments as come within the scope of the following claims.

Claims

1. A method of processing a set of sampled image data to steganographically encode therein plural bits of auxiliary data, the set of sampled image data comprising plural samples, each having a value, the method including altering at least certain of said sample values to encode the auxiliary data in said set of sampled data, such that the alterations are generally imperceptible in presentation of the image to humans, but are detectable by computer analysis, **characterised in that** the alterations also include steganographically encoding calibration data in the image data, the calibration data having an attribute permitting its discernment notwithstanding transformation of the image data by at least one of scaling, rotation, or misregistration.

2. The method of Claim 1 in which the attribute (1002; 1006) is a characteristic in the spatial frequency domain.

3. The method of Claim 1 in which the sampled image data comprises pixels.

4. The method of any preceding claim in which the calibration data includes a pattern of spots in a spatial frequency representation of said image data.

5. The method of any preceding claim in which the calibration data is distinct from the auxiliary data.

6. The method of any one of Claims 1 to 4 in which the calibration data and the auxiliary data are related.

7. The method of Claim 6 in which the auxiliary data is modulated on the calibration data.

8. The method of any preceding claim in which the calibration data is encoded by adding an overlay signal to the image data.

9. The method of any preceding claim that further includes transforming the encoded image by at least one of scaling,

rotation, or misregistration, and decoding the auxiliary data therefrom notwithstanding said transformation.

10. The method of any preceding claim that further includes transforming the encoded image by both scaling and rotation, and decoding the auxiliary data therefrom notwithstanding said rotation.

11. The method of any preceding claim in which the calibration data, when represented in a spatial frequency representation, has at least one axis of symmetry.

12. The method of any preceding claim in which the calibration data, when represented in a spatial frequency representation, has at least four axes of symmetry.

13. The method any preceding claim in which the calibration data, when represented in a spatial frequency representation, includes spatial frequencies falling along a circle (1006) centred at an origin of a UV Plane.

14. The method of any preceding claim in which the processing includes processing with at least one random factor.

15. A set of sampled image data processed in accordance with any of the preceding claims.

16. A document having a substrate, the substrate carrying a photograph, the photograph having been processed in accordance with any one of Claims 1 to 15.

17. A method of steganographically decoding plural bits of auxiliary data from sampled image data that has previously been encoded by changing the values of certain samples thereof, characterised by detecting steganographically embedded calibration data in the image data, and inferring from an attribute of said embedded calibration data certain transformation information about the image data, said transformation information relating to at least one of scaling, rotation or misregistration.

18. The method of Claim 17 that further comprises decoding the auxiliary data from the image data by reference to said certain transformation information.

19. The method of Claim 17 that includes processing the image data to remove a transformation effect therefrom.

20. The method of Claim 19 that includes counter-rotating the image data.

21. The method of Claim 19 that includes counter-scaling the image data.

22. The method of Claim 19 that includes re-registering the image data.

23. The method of any one of Claims 17 to 22 that includes decoding the auxiliary data without reference to unencoded image data.

24. The method of Claim 17 that includes decoding the auxiliary data with reference to one or more random factors with which the image data has been encoded.

Patentansprüche

1. Verfahren zum Verarbeiten einer Gruppe abgetasteter Bilddaten zum steganographischen Codieren mehrerer Bits von Hilfsdaten darin, wobei die Gruppe der abgetasteten Bilddaten mehrere Abtastwerte umfaßt, die jeweils einen Wert haben, mit den Verfahrensschritten: Verändern wenigstens bestimmter Abtastwerte zum Codieren der Hilfsdaten in der Gruppe der abgetasteten Daten, so daß die Änderungen in der Darstellung des Bildes für Menschen im wesentlichen nicht wahrnehmbar sind, jedoch durch Computeranalyse wahrnehmbar sind, **dadurch gekennzeichnet, daß** die Änderungen auch steganographisch codierte Kalibrierdaten in den Bilddaten umfassen, wobei die Kalibrierdaten ein Attribut umfassen, welches die Erkennung unabhängig von der Transformation der Bilddaten durch Skalierung, Rotation und/oder Fehlausrichtung erlaubt.

2. Verfahren nach Anspruch 1, bei dem das Attribut (1002, 1006) eine Eigenschaft in dem räumlichen Frequenzbereich ist.

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